

C-364

**MIL-C-765B**

**12 DECEMBER 1961**

**SUPERSEDING**

**MIL-C-765A**

**9 MAY 1952**

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**MILITARY SPECIFICATION**

**CLOTH, CAMOUFLAGE: IMPREGNATED,  
FLAME-RESISTANT; OSNABURG AND BURLAP;  
100-YARD ROLLS**

*This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.*

**1. SCOPE**

**1.1 Scope.** This specification covers camouflage cloth of impregnated cotton Osnaburg and jute or kenaf burlap.

**1.2 Classification.** Cloth shall be of the following types and colors, as specified (see 6.2):

**Type I — Cotton Osnaburg.**

**Color No.**

1. Light green.
2. Dark green.
3. Sand.
4. Field drab.
5. Earth brown.
6. Earth yellow.
8. Earth red.
9. Olive drab.

11. White.

12. Forest green.

13. Desert sand.

**Type II — Jute or kenaf burlap.**

**Color No.**

1. Light green.
2. Dark green.
3. Sand.
4. Field drab.
5. Earth brown.
6. Earth yellow.
8. Earth red.
9. Olive drab.
10. Black.
12. Forest green.
13. Desert sand.

**FSC 1080**

## 2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids form a part of this specification to the extent specified herein:

### SPECIFICATIONS

#### FEDERAL

- QQ-S-781 — Steel, Strapping, Flat.
- UU-P-271 — Paper, Wrapping, Waterproofed Kraft.
- CCC-C-429 — Cloth, Cotton, Osna-burg.
- CCC-C-467 — Cloth, Jute (or Ken-af), Burlap.
- CCC-T-191 — Textile Test Methods.
- PPP-B-601 — Boxes, Wood, Cleated-Plywood.
- PPP-B-621 — Boxes, Wood, Nailed and Lock-Corner.

#### MILITARY

- MIL-A-140 — Adhesive, Water-Re-sistant, Waterproof Barrier-Material.

### STANDARDS

#### FEDERAL

- FED. STD. 4 — Glossary of Fabric Im-perfections.
- FED. TEST METHOD STD. No. 141 — Paint, Varnish, Lac-quer, and Related Materials; Methods of Inspection, Samp-ling, and Testing.

#### MILITARY

- MIL-STD-105 — Sampling Procedures and Tables for In-spection by Attrib-utes.

MIL-STD-129 — Marking for Shipment and Storage.

MIL-STD-130 — Identification Mark-ing of U. S. Military Property.

(Copies of specifications and standards required by contractors in connection with specific procure-ment functions should be obtained from the procur-ing activity or as directed by the contracting of-ficer.)

2.2 Other publications. The following doc-uments form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of in-vitation for bids shall apply.

#### OFFICIAL CLASSIFICATION COMMITTEE Uniform Freight Classification Rules.

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd Street, New York 16, N. Y.)

#### AMERICAN TRUCKING ASSOCIATION National Motor Freight Classification Rules.

(Application for copies should be addressed to the American Trucking Association, 1616 P Street NW, Washington 6, D. C.)

## 3. REQUIREMENTS

3.1 Description. The cloth shall be either Osnaburg cotton cloth or jute or kenaf bur-lap, as specified, treated with a compound that will produce a camouflage cloth as specified herein. The camouflage cloth shall be treated to render it flame retardant and mildew re-sistant and to make the impregnation water-insoluble.

3.2 Preproduction model. The preproduction model is defined as a production model which will be identical to the camouflage cloth which the manufacturer will subsequently produce in fulfillment of the contract. As soon as practicable after award of the contract and prior to the submission of any camouflage

cloth for final acceptance, the contractor shall furnish 10 yards of 40-inch-width camouflage cloth of each color to be produced for examination and test to determine conformance to this specification. Examination and tests shall be those specified herein. Approval of the preproduction model by the activity concerned shall not relieve the contractor of his obligation to supply camouflage cloth conforming to this specification. Any changes or deviations of production camouflage cloth from the preproduction model shall be subject to the approval of the contracting officer.

**3.3 Material.** Material shall be as specified herein. Material not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

#### 3.3.1 Cloth.

**3.3.1.1 Type I (cotton Osnaburg).** Type I cloth before impregnation shall conform to Specification CCC-C-429, type II, class 2, finish A.

**3.3.1.2 Type II (jute or kenaf burlap).** Type II cloth before impregnation shall conform to Specification CCC-C-467, class optional.

**3.3.2 Compound.** The formulation of the compound used to impregnate the cloth shall be optional with the contractor except that in formulating color numbers 1, 2, 9, and 12 for both types I and II, only those pigments specified in 3.4 shall be used. The formulation used shall not produce skin irritation or other effects deleterious to the health of personnel under the proposed conditions of use.

**3.4 Prime pigment.** The prime pigment formulations (see 6.4) used to produce each color number 1, 2, 9, and 12 for types I and II (see table I) shall include titanium dioxide ( $\text{TiO}_2$ ), cobaltous hydroxide ( $\text{Co}(\text{OH})_2$ ), calcium carbonate ( $\text{CaCO}_3$ ), barium chromate ( $\text{BaCrO}_4$ ), zinc oxide ( $\text{ZnO}$ ), manganese dioxide ( $\text{MnO}_2$ ), and ferric oxide ( $\text{Fe}_2\text{O}_3$ ),

necessary to meet requirements of this specification. The prime pigments or any combination thereof shall be the principal ingredients to obtain the specified colors of the impregnated cloth. A minimum of  $4\frac{1}{2}$  pounds of the prime pigments per gallon of compound shall be used. When the compound is tested as specified in 4.4.3.1, the amount of cobalt titanate ( $\text{CoTiO}_3$ ) expressed as cobaltous oxide and titanium dioxide shall be as shown in table I.

TABLE I. Cobalt titanate required in compound to provide required pigmentation of cloth.

Color No.	Color name	Cobaltous oxide ( $\text{CoO}$ ) minimum	Titanium dioxide ( $\text{TiO}_2$ ) min.
		lb. per gal.	lb. per gal.
1	Light green	0.60	3.10
2	Dark green	0.58	3.30
9	Olive drab	0.59	3.00
12	Forest green	0.59	3.10

**3.4.1 Pigment particle size.** The particle size shall be as specified in table II. The tolerance for the average particle size shall be plus or minus 0.20 micron.

TABLE II. Particle size of pigment.

Color No.	Microns
12	2.5
9	2.5
2	2.5
1	2.3

**3.4.2 Spectral reflectance.** The spectral reflectance of the pigment shall be in accordance with figures 3 through 6 for the pigment specified. Any deviation shall be not more than plus or minus 1 percent from the applicable figure throughout the spectral range from 400 to 900 millimicrons.

**3.4.3 Color durability.** When the pigments are heat aged in accordance with 4.4.3.2.3, they shall show no change in the spectral reflectance specified in 3.4.2.

**3.4.4 Tinting pigments.** The following tinting pigments: antimony sulfide, medium



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chrome yellow, light chrome yellow, light chrome orange, yellow iron oxide, and red iron oxide may be used together with the prime pigments previously indicated to meet the color number and other requirements of the cloth.

**3.5 Processing.** The cloth shall be thoroughly impregnated with compound, excess compound shall be removed, and all volatile solvents and excess moisture shall be driven off by thorough drying of the impregnated cloth.

**3.5.1 Weight increase.** After the impregnated cloth is dried, the processed cloth shall show a weight increase of not more than 55 percent based on the weight of the cloth before processing, except for types I and II, color numbers 1, 2, 9, and 12 which shall show a weight increase or not more than 65 percent.

**3.5.2 Impregnation.** The compound shall penetrate into the yarns and saturate the cloth so as to cause an even, uniform coloration leaving none of the original color of the visible. The compound shall penetrate between the warp and filling yarns so that at points of contact of the yarns no uncolored yarn will result.

**3.5.3 Texture.** Except for type I, color No. 11, the texture of the processed cloth shall be essentially the same as that of the cloth before processing. During processing, no nap or fuzz shall be removed from the cloth except loose material that otherwise would be lost in normal impregnation and drying operations. The compound shall not form a continuous film on the yarns of the cloth, nor shall it bind down the nap and fuzz of the threads. The character of the processed cloth shall be such that the fuzzy texture will be restored after the processed cloth has been subjected to the dusting test specified in 4.4.3.3.4.

**3.6 Flexibility.** Except for type I, color No. 11, the flexibility of the processed cloth

shall be essentially the same as that of the cloth before processing. For type I, color No. 11, a slight stiffening of the processed cloth will be acceptable.

**3.7 Tackiness.** Folds of the treated cloth shall not adhere to each other.

**3.8 Dusting.** A strip of the treated cloth shall not show excessive loss of compound when the cloth is tested as specified in 4.4.3.3.4.

**3.9 Solubility.** The compound used in treating the cloth shall not be soluble in water. No discoloration of the water shall be noted when the treated cloth is tested for solubility as specified in 4.4.3.3.5 but a slight turbidity will be acceptable.

**3.10 Loss in tensile strength.** The tensile strength of the treated cloth shall be not less than the tensile strength of the untreated cloth.

**3.10.1 Accelerated weathering.** The tensile strength of the treated cloth after being subjected to the 150 hours accelerated weathering shall be not less than 30 percent of the unweathered cloth for burlap and not less than 70 percent of the unweathered cloth for Osnaburg cloth.

**3.10.2 Heat aging.** After heat aging, the breaking strength of the treated cloth shall be not less than 70 percent of the breaking strength of the unheated treated cloth.

**3.11 Self heating.** When the cloth is tested in accordance with test method 5920 of Specification CCC-T-191, the temperature in a roll of treated cloth shall not exceed plus 220°F.

**3.12 Flame resistance.** The average char length in the treated cloth shall be as shown in table III. Afterglow shall be not more than 15 seconds after the flame is extinguished or after the cloth ceases to burn, before and after accelerated weathering and after leaching.



TABLE III. Char length before and after conditioning.

Conditioning	Maximum char length
	<i>inches</i>
Prior to conditioning .....	2½
After accelerated weathering .	4
After leaching .....	4

**3.13 Color.** The color of the treated cloth shall be such that a plot of the trichromatic coefficients (x and y coordinates) shall fall within the applicable polygon of figure 2, and the apparent reflectance (Y) shall fall within the applicable tolerances specified in figure 2.

**3.14 Color durability.** After the treated cloth has been subjected to accelerated weathering, heat aging, and accelerated aging, the apparent reflectance (Y value)

shall be not more than 20 percent above that of the treated cloth before conditioning. The plot of the trichromatic coefficients shall fall within the applicable polygon of figure 2.

**3.15 Crocking.** When tested in accordance with test method 5650.1 of Specification CCC-T-191, the treated cloth shall show no change in color.

**3.16 Gloss.** Except for type I, color No. 11, the treated cloth shall have a gloss with diffuse component excluded of not more than 0.6.

**3.17 Reflectance values.** The treated cloth, both before and after being subjected to the accelerated weathering, heat aging, and accelerated aging tests, shall have reflectance values within the limits shown in table IV.

TABLE IV. Color reflectance in the red and infrared spectral regions.

Cloth color No.	Color	Color reflectance related to magnesium oxide (MgO)				
		Infrared spectral range		Red spectral range		Allowable ratio <sup>1</sup>
		Percent		Percent		
		max.	min.	max.	min. <sup>2</sup>	min.
1	light green .....	65.0 <sup>3</sup>	39.0	10.0	7.5	4.1
2	dark green .....	65.0 <sup>3</sup>	39.0	7.4	6.4	5.5
3	sand .....	100.0	24.5	...	...	...
4	field drab .....	57.0	24.5	...	...	...
5	earth brown .....	57.0	24.5	...	...	...
6	earth yellow .....	100.0	24.5	...	...	...
8	earth red .....	57.0	24.5	...	...	...
9	olive drab .....	55.0	32.0	8.0	6.0	4.8
10	black .....	24.5	0	...	...	...
11	white .....	100.0	57.0	...	...	...
12	forest green .....	57.0	32.0	6.4	5.0	6.0
13	desert sand .....	100.0	24.5	...	...	...

<sup>1</sup> The ratio is calculated by dividing the value of the infrared spectral range by the value of the red spectral range.

<sup>2</sup> The minimum requirements for the red spectral range shall apply to the cloth before weathering (no minimum requirement is necessary after weathering).

<sup>3</sup> The minimum requirements for the infrared spectral range after weathering shall be 37.0 percent.

**3.18 Width and length.** The treated cloth shall be furnished in rolls containing 100 lineal yards plus or minus 2 lineal yards and in 2-inch to 2 $\frac{1}{4}$ -inch widths or 40-inch widths, as specified (see 6.2).

**3.19 Identification marking.** Each roll shall be marked in accordance with Standard MIL-STD-130.

**3.20 Workmanship.** The finished cloth as treated shall be clean and free from all foreign matter.

#### 4. QUALITY ASSURANCE PROVISIONS

**4.1** The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

**4.2 Classification of inspection.** Inspection shall be classified as follows:

- (a) Preproduction inspection of the camouflage cloth.
- (b) Production inspection of the camouflage cloth.
- (c) Inspection of preparation for delivery.

#### 4.3 Preproduction inspection.

**4.3.1 Examination.** The camouflage cloth shall be examined as specified in 4.4.2. Presence of one or more defects shall be cause for rejection.

**4.3.2 Tests.** The camouflage cloth shall be tested as specified in 4.4.3. Failure to pass

any test shall be cause for rejection.

**4.4 Production inspection of the camouflage cloth.**

##### 4.4.1 Sampling.

**4.4.1.1 For examination.** Sampling for examination shall be in accordance with Standard MIL-STD-105.

##### 4.4.1.2 For tests.

**4.4.1.2.1 Sampling for prime pigment.** Not less than 8 ounces of the prime pigment of each lot shall be submitted for production tests. This shall be applicable to pigments for color numbers 1, 2, 9, and 12 only.

**4.4.1.2.2 Sampling for compound.** Not less than 1 quart of the compound of each lot used in formulating color numbers 1, 2, 9, and 12 shall be submitted for production tests.

**4.4.1.2.3 Sampling for color measurements.** Sampling for color measurements shall consist of taking specimens of not less than 6 inches wide and 12 inches long from production not exceeding 2,200 square yards of material produced. Not less than 25 percent shall be measured for trichromatic coefficients and in the spectral ranges given in table IV.

**4.4.1.2.4 Sampling for tests other than color.** Samples for testing shall be taken at regular production intervals as specified (see 6.2). The entire production processed during the interval chosen shall be represented by the samples taken for that interval, and acceptance or rejection of the entire lot shall be based on the test results of the samples representing the lot in question.

**4.4.2 Examination of treated camouflage cloth.** The treated camouflage cloth selected as specified in 4.4.1.1 shall be examined as specified in 4.4.2.1 to 4.4.2.2 inclusive,

**4.4.2.1 Yard-by-yard examination.** The required yardage of each piece shall be ex-

amined, and the visual defects shall be classified as listed in table V. The defects shall be counted regardless of their proximity to each other except where two or more defects represent a single condition of the cloth, in which case only the more serious or the major defect shall be counted. A continuous defect shall be counted as one defect

for each warpwise yard or fraction thereof in which it occurs. The unit of product for this examination shall be 1 lineal yard. The lot size shall be expressed in units of 1 yard each. Acceptance and rejection shall be based on an AQL for 1.5 total defects per 100 units for major defects and an AQL of 6.5 total defects per 100 units for minor defects.

TABLE V. *Classification of defects.*

Examine	Defect <sup>1</sup>	Classification	
		Major	Minor
Cut, hole or tear .....	More than three yarns ruptured at adjoining points	X	...
Smash .....	Any .....	X	...
	Three or more contiguous regardless of length missing .....	X	...
	Two contiguous, 2 inches or more missing .....	X	...
Broken or missing yarns ..	Two contiguous, less than 2 inches missing .....	...	X
	Single end, 2 inches or more missing .....	...	X
	Single pick, more than ¼ of width missing .....	...	X
Fine filling bar or light place .....	Clearly noticeable .....	X	...
Open place, crack or hitchback .....	Opening at widest point four or more normal yarn diameters .....	X	...
	Multiple, 1 inch or more in combined warp and filling directions .....	X	...
Floats or skips .....	Multiple, less than 1 inch in combined warp and filling directions, or single floating over 2 inches or more .....	...	X
Selvage scalloped .....	Deepest indentation more than ½ inch .....	...	X
Selvage cut or torn .....	Any cut or tear .....	X	...
Tender or weak place ....	Any .....	X	...
Spot, stain, or streak (other than dye or finishing compound) .....	Clearly noticeable at 6 feet distance and exceeding 1 inch in combined directions .....	...	X

<sup>1</sup> Definitions shall be as specified in Standard FED. STD. No. 4.

#### 4.4.2.2 Examination for length.

**4.4.2.2.1 Individual pieces.** The piece shall be examined for gross length. Any piece found to be less than the minimum gross length specified, more than 2 yards below gross length marked on the ticket, or more than one continuous length shall be considered a defect with respect to length. The unit of product for this examination shall be one piece. The samples shall be selected as specified in 4.4.1.1, inspection level II.

#### 4.4.2.2.2 Total yardage in sample. The lot

shall be unacceptable if the total of the actual gross lengths of the pieces in the sample is less than the total gross lengths marked on the tickets.

**4.4.3 Tests.** Samples selected as specified in 4.4.1.2.1 to 4.4.1.2.4, inclusive, shall be tested as follows. Failure to pass any test shall be cause for rejection.

**4.4.3.1 Chemical analysis of compound.** Using approximately 200 milliliters of compound used for color numbers 1, 2, 9, and 12 measured to the nearest 0.1 milliliter,



separate the pigment from the vehicle by using xylene or by drying the compound and reducing the remaining solids to ash in a muffle furnace, and determine the weight per gallon of extracted or ashed material. Using approximately half the ash or separated pigment which has been weighed to the nearest milligram, determine the titanium dioxide ( $\text{TiO}_2$ ) in the ashed or extracted material in accordance with FED. TEST METHOD STD. NO. 141, method 7081 or 7082. Using the remaining sample weighed to the nearest milligram determine the cobaltous oxide ( $\text{CoO}$ ) in accordance with FED. TEST METHOD STD. NO. 141, method 7231, in the extracted or ashed material. If the values obtained are less than as specified in table I, the sample shall have failed this test.

**4.4.3.2 Prime pigment tests.** The prime pigment used to obtain color numbers 1, 2, 9, and 12 shall be tested as specified in 4.4.3.2.1, 4.4.3.2.2, and 4.4.3.2.3.

**4.4.3.2.1 Particle size test.** Using a portion of the sample specified in 4.4.1.2.1, determine the particle size of the pigment with a Fisher Sub-Sieve Sizer produced by the Fisher Scientific Company. The results shall be compared with the values specified in table II. Failure to conform to the particle size requirements shall constitute failure of this test.

**4.4.3.2.2 Spectral reflectance test.** The spectral reflectance shall be determined in accordance with Standard FED. TEST METHOD STD. NO. 141, method 4252, except the specular component shall be excluded. The measurements shall be made in the wavelength region between 400 and 900 millimicrons with a General Electric Hardy Recording Spectrophotometer. The sample shall be pressed into a cylindrical shape 3/16-inch-thick by 1½-inch-diameter in a circular container at a pressure of 2,000 psi. The infrared values shall be determined at 780 millimicrons. The results shall be compared with figures 3 through 6. A deviation of more than plus or minus 1 percent from

the applicable figure (see figs. 3 through 6) throughout the spectral range from 400 to 900 millimicrons shall constitute failure of this test.

**4.4.3.2.3 Color durability test.** The color durability shall be determined by conditioning the pigment at a temperature of plus 100°C. for not less than 12 hours and determining the spectral characteristics as specified in 4.4.3.2.2. The pigment shall be considered defective if there is a change in spectral reflectance.

#### **4.4.3.3 Treated cloth tests.**

**4.4.3.3.1 Weight increase test.** Using a running yard of unimpregnated cloth, determine the weight of the cloth to the nearest 0.1 gram. In a like manner, determine the weight of the impregnated cloth. The cloth length shall be measured to the nearest ¼-inch, and the widths of the impregnated and unimpregnated cloth shall be within ⅛-inch of each other. Calculate the weight pick-up of impregnant. Failure to conform to the requirements specified in 3.5.1 shall constitute failure of this test.

**4.4.3.3.2 Color uniformity.** Using a piece of impregnated cloth approximately 4 inches square, remove two warp threads and two fill threads. Examine the threads for color uniformity and impregnation by breaking up the thread down the axis of the thread. If the threads are not uniformly colored throughout the length and when broken down the axes of the threads, the cloth shall have failed this test.

**4.4.3.3.3 Tackiness test.** A piece of treated cloth 2 by 6 inches shall be conditioned for 3 hours at 100°F. plus or minus 5°F. and 95 to 100 percent relative humidity. The cloth shall be folded, and a pressure of 2 pounds per square inch shall be applied for a period of 4 hours at 150°F. plus or minus 5°F. Adherence of the folds of the treated cloth to each other shall constitute failure of this test.

4.4.3.3.4 *Dusting test.* A strip of treated cloth 2 feet long shall be hung over a  $\frac{1}{8}$ -inch-diameter metal rod. The rod shall be in a horizontal position. A 100-gram weight shall be clamped to one end of the strip and a 1,000-gram weight clamped to the other end. The cloth shall be allowed to fall freely, dragging itself over the rod. This shall be done 10 times. The length of the fall shall be 18 inches. Excessive loss of compound of the treated cloth or inability of the cloth to retain its fuzzy texture shall constitute failure of this test.

4.4.3.3.5 *Solubility test.* A 2- by 6-inch piece of treated cloth shall be immersed for 24 hours in a 400-cubic centimeter glass beaker filled with distilled water at a temperature of 70°F. plus or minus 10°F. If the compound used on the treated cloth is soluble in water or a discoloration of the water is noted during the test, the treated cloth shall be considered defective.

4.4.3.3.6 *Flame-resistance test.* The flame resistance shall be determined by the vertical test method as described herein.

4.4.3.3.6.1 *Specimen.* The test specimen shall be 1 inches long and 2 to 3 inches wide.

4.4.3.3.6.2 *Apparatus.*

(a) *Cabinet and specimen holder.* The cabinet and specimen holder shall be as specified in Specification CCC-T-191, method 5902, except that the arms of the specimen holder shall be  $1\frac{1}{2}$  inches apart. A scale graduated in  $\frac{1}{8}$ -inch increments shall be drawn up the length of each arm of the holder, starting at the bottom.

(b) *Straight edge.* A straight edge which lines up on the arms of the holder shall be used to determine the length of the specimen burned.

(c) *Ignition flame apparatus.* Ignition flame shall be provided by burn-

ing 0.3 milliliter of 95 percent by weight ethyl alcohol in a round, flat-bottomed brass cup mounted on a pedestal composed of a low-heat material such as cork. The cup and pedestal shall have the dimensions as described in figure 1. A wooden block shall be used under the pedestal to provide a distance of 1 inch from the top of the pedestal to the bottom of the specimen.

(d) *Pipette.* Pipette shall be graduated in 0.1-milliliter increments. Binder clips shall be provided to hold the bottom of the specimen holder together.

4.4.3.3.6.3 *Procedure.* The specimen shall be placed in the holder with the bottom of the specimen on a line with the bottom of the holder. The arms of the holder shall be held together at the bottom with binder clips, and the holder shall be positioned inside the cabinet. The pedestal and wooden block shall be placed in the cabinet so that the center of the cup, when placed on the pedestal, will directly below the center of the specimen. The alcohol shall be placed in the cup, the cup shall be placed in position, and the alcohol shall be immediately ignited. The door of the cabinet shall be closed immediately after the alcohol is ignited and shall remain closed until all the alcohol has burned and the afterglow of the specimen has stopped. While the specimen is still in the holder, the charred area of the specimen shall be removed by running a pencil or similar object through the burned section of the specimen. The length of the specimen char shall be measured by placing the straightedge across the top of the charred area and reading the length marked on the arms of the holder to the nearest  $\frac{1}{8}$  inch. Failure to conform to the requirements of 3.12 shall constitute failure of this test.

*Note.* After each specimen of a series of specimens is tested, the air in the cabinet shall be changed or evacuated and the brass cup cooled to

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room temperature before the next specimen is tested.

**4.4.3.3.7 Leaching test.** Using a 15-inch long by 2- to 3-inch wide specimen, place the specimen in 450-ml to 500-ml of distilled water for 24 hours. The temperature of the water shall be maintained at plus 120°F. plus or minus 5°F. for the leaching period. After the leaching period, the specimen shall be dried at room temperature for 8 hours and then conditioned at plus 120°F. for 40 hours. After the 40-hour conditioning period, the specimen shall be tested for flame resistance as specified in 4.4.3.3.6. If the average char length is greater than as specified in table III, the sample shall have failed this test.

### 4.4.3.3.8 Color test.

**4.4.3.3.8.1 Acceptable quality level for color.** The camouflage cloth shall be considered to have satisfied the color requirements provided that:

- (a) The arithmetic average of all the samples representing the lot falls within the specified tolerances.
- (b) Not less than 90 percent of the individual samples representing the lot fall within the specified tolerances.
- (c) Not more than 10 percent of the individual samples representing the lot exceed the specified tolerances by not more than 0.003 for each of the trichromatic coefficients (x and y).
- (d) Not more than 10 percent of the individual samples representing the lot exceed the specified tolerances for apparent reflectance by not more than plus or minus 4 percent. (For example, color No. 1, which has a specified tolerance of 0.098 to 0.123 would be acceptable provided not more than 10 percent exceeded these tolerances but did not exceed 0.094 to 0.128.)

**4.4.3.3.8.2 Acceptable quality level for color durability.** The camouflage cloth shall be considered to have satisfied the color-durability requirements provided that not less than 80 percent of the individual samples representing the lot meet the specified requirements after conditioning in accordance with Specification CCC-T-191, test methods 5804, 5851, and 5660. Exposure time for test method 5660 shall be 40 hours.

### 4.4.3.3.8.3 Color determination.

**4.4.3.3.8.3.1 Preparation of sample.** The sample to be measured shall be cut into three pieces, each being not less than 4 inches wide and 6 inches long. The three pieces shall be stapled smoothly onto a gray cardboard 4 by 6 inches in size so as to provide three thicknesses of cloth.

**4.4.3.3.8.3.2 Procedure.** The trichromatic coefficients (x and y) and apparent reflectance (Y) and all other spectral measurements shall be determined in accordance with Standard FED. TEST METHOD STD. NO. 141, method 4251, using standard illuminant C and the Hardy General Electric Recording Spectrophotometer with all specular components excluded. Two determinations shall be made: one with the sample placed so that the warp yarns are horizontal, and again with the sample rotated 90° in position. For each sample, the average of the two determinations shall be reported. Failure to conform to the requirements specified in 3.13 and 3.14 shall constitute failure of this test.

**4.4.3.3.8.3.3 Alternate procedure.** The trichromatic coefficients and apparent reflectance may be determined for colors other than color numbers 1, 2, 9, and 12 in accordance with Standard FED. TEST METHOD STD. NO. 141, method 4252, making two determinations on each sample as described above using samples prepared in a similar manner. When this method is used, the results shall



be adjusted to correlate with the results obtained by method 4251 of Standard FED. TEST METHOD STD. NO. 141, and the adjusted results shall be reported. In order to obtain the adjustment figures, not less than five samples of each type and color of treated cloth shall be tested by both methods, and the amount of adjustment required shall be noted from the average differences between the methods. This correlation should be repeated for each color every time a change is made in the compound used for impregnating the cloth. The procedure for determination of color shall be as specified herein. The alternate procedure shall not be used to determine the color for color numbers 1, 2, 9, and 12.

**4.4.3.3.9 Gloss test.** The specular gloss of treated cloth shall be determined as specified in Standard FED. TEST METHOD STD. NO. 141, method 6101, with an instrument capable of measuring gloss to 0.1 gloss unit. The samples shall be prepared as specified in 4.4.3.3.8.3.1. Any sample having a gloss of more than 0.6 shall be defective and shall constitute failure of this test.

**4.4.3.3.10 Spectral reflectance test.** The treated cloth shall be tested as follows after being conditioned in accordance with Specification CCC-T-191, test methods 5804, 5851, and 5660. A National Weathering Unit and an exposure of 150 hours shall be used for test method 5804. Specimen for test method 5851 shall be 7 by 14 inches. Exposure time for test method 5660 shall be 40 hours.

**4.4.3.3.10.1 Sample preparation.** Samples shall be prepared as specified in 4.4.3.3.8.3.1.

**4.4.3.3.10.2 Procedure.** The spectral reflectance shall be determined by the Hardy Recording Spectrophotometer method or the Hunter Multipurpose Reflectometer in accordance with Standard FED. TEST METHOD STD. NO. 141, method 6241 or 6242, respectively. The ordinates to be used shall be those given in the Standard FED. TEST METHOD STD. NO. 141, method 6241, except for types I and II, color numbers 1, 2,

9, and 12, which shall use the ordinates shown in table VI.

**4.4.3.3.10.2.1 Hardy recording spectrophotometer method.** If this method is used, infrared reflectance values shall be obtained by averaging the reflectance percentages measured at values given.

TABLE VI. Selected ordinates for determining infrared and red reflectance values from spectrophotometric curves for types I and II, color numbers 1, 2, 9, and 12.

Ordinates		
Red region	Infrared region	
Millimicrons	Millimicrons	
626.5	714.5	729.7
638.0	724.7	797.2
645.3	731.4	801.6
649.0	737.0	806.6
651.5	742.3	811.3
653.5	746.8	816.2
655.5	751.3	821.1
658.5	755.7	826.0
663.0	760.0	831.1
669.0	764.3	836.0
	768.7	842.1
	773.0	848.0
	777.4	854.5
	782.8	862.2
	787.3	873.0

**4.4.3.3.10.2.2 Hunter multipurpose reflectometer method.** If this method is used, a Wratten No. 88 or 89B filter shall be used with the instrument, and neutral standards calibrated by the Hardy Recording Spectrophotometer method shall be used.

**4.4.3.3.10.3 Report of results.** Two determinations shall be made on each sample: one with the sample placed so that the warp yarns are horizontal; and again with the sample rotated 90° in position. For each sample, the average of the two determinations shall be reported. Any sample with reflectance values outside the limits shown in table IV shall have failed this test.

**4.4.3.3.11 Flexibility test.** The treated cloth shall be tested in accordance with Specification CCC-T-191, method 5204.

**4.4.3.3.12 Tensile test.** Strips of treated and untreated cloth 2 inches wide shall be tested in accordance with Specification CCC-T-191, method 5104, in a testing machine with 3-inch jaws. Any reduction in the tensile strength after treatment shall be cause for rejection. Tensile tests shall also be performed after the following conditioning.

**4.4.3.3.12.1 Accelerated weathering.** The cloth shall be conditioned in accordance with Specification CCC-T-191, method 5804, with a National Weathering Unit and an exposure of 150 hours. A tensile strength of less than 30 percent of the unweathered cloth for burlap or less than 70 percent of the unweathered cloth for Osnaburg shall constitute failure of this test.

**4.4.3.3.12.2 Heat aging.** Specimens 7 by 14 inches shall be conditioned in accordance with Specification CCC-T-191, method 5851. A tensile strength of less than 70 percent of the tensile strength of the unconditioned cloth shall constitute failure of this test.

**4.4.3.3.13 Self-heating test.** A specimen of the cloth shall be conditioned at standard conditions and tested in accordance with Specification CCC-T-191, method 5920. Temperature in a roll of treated cloth in excess of 220°F. shall constitute failure of this test.

**4.4.3.3.14 Crocking test.** The treated cloth shall be tested in accordance with Specification CCC-T-191, method 5650.1. Any change in color shall constitute failure of this test.

**4.4.3.15 Mildew test.** The treated cloth shall be tested in accordance with Specification CCC-T-191, method 5758.

**4.5 Inspection of preparation for delivery.** The packaging, packing, and marking shall be examined to determine compliance with section 5 of this specification.

## 5. PREPARATION FOR DELIVERY

**5.1 Packaging.** Packaging shall be level A or C as specified (see 6.2).

### 5.1.1 Level A.

**5.1.1.1 Rolls, 2- to 2¼-inch-wide cloth.** Rolls of cloth of like description shall be stacked in quantities of 10 rolls, and each stack shall be secured with two ties of soft, annealed wire placed through the center of the stack and over the ends outside of the stack, diametrically opposite each other. The ends of the wire ties shall be flattened to the inside of the stack so as not to damage the wrap specified. Each stack shall be wrapped with paper conforming to Specification UU-P-271, class H-3, with all folds, seams, and laps sealed with adhesive conforming to Specification MIL-A-140, except the wrap will not be required for cloth to be packed as specified in 5.2.1.1.2.

**5.1.1.2 Rolls, 40-inch-wide cloth.** Each roll of cloth shall be secured with not less than two ties of soft, annealed wire with the ends of the wire ties flattened in a manner not to damage the wrap specified. Each roll shall be wrapped, and the wrap shall be sealed as specified in 5.1.1.1 for 2- to 2¼-inch-wide rolls, except that the wrap will not be required for cloth to be packed as specified in 5.2.1.1.2.

**5.1.2 Level C.** The rolls of cloth shall be packaged to afford protection against deterioration and damage.

**5.2 Packing.** Packing shall be level A, B, or C as specified (see 6.2).

**5.2.1 Level A.** Unless otherwise specified, rolls of cloth 2 to 2¼ inches wide, packaged as specified in 5.1.1.1, shall be packed in quantities of four packages; and rolls of cloth 40 inches wide, packaged as specified in 5.1.1.2, shall be packed in quantities of two packages both sizes in close-fitting boxes conforming to Specification PPP-B-621, class 2, style optional, or PPP-B-601, overseas type, style optional. The boxes shall be closed and strapped in accordance with the appendix to the applicable box specification. Strapping shall be zinc coated.

### 5.2.1.1 Alternate packing.

**5.2.1.1.1 Cloth.** When specified (see 6.2), rolls of cloth 2 to 2 $\frac{1}{4}$  inches wide packaged as specified in 5.1.1.1 in quantities of two packages or each roll of cloth 40 inches wide packaged as specified in 5.1.1.2 shall be packaged in an Osnaburg cotton cloth or burlap tube. Prior to being packed, the packages of 2- to 2 $\frac{1}{4}$ -inch rolls shall be secured together with one lengthwise and two girthwise straps conforming to Specification QQ-S-781, class B, size as applicable. The tubing shall be wire tied at the ends.

**5.2.1.1.2 Cloth.** When specified (see 6.2), rolls of cloth 2 to 2 $\frac{1}{4}$  inches wide packaged as specified in 5.1.1.1 in quantities of two packages or each roll of cloth 40 inches wide packaged as specified in 5.1.1.2 shall be wrapped with paper conforming to Specification UU-P-271, class G-3(c). The ends of the wraps shall be double folded and sewed. All seams and laps shall be sealed with adhesive conforming to Specification MIL-A-140.

**5.2.2 Level B.** Packing shall be as specified in 5.2.1, except the container shall conform to Specification PPP-B-621, class 1, or PPP-B-601, domestic type. Zinc-coated strapping is not required. When specified (see 6.2), packing shall conform to the alternate provisions of 5.2.1.1.1 and 5.2.1.1.2.

**5.2.3 Level C.** The rolls of cloth shall be packed to assure carrier acceptance and safe delivery to destination at lowest rates in containers complying with Uniform Freight Classification Rules, National Motor Freight Classification Rules, or other carrier rules applicable to the mode of transportation.

**5.3 Marking.** Packages and shipping containers shall be marked in accordance with Standard MIL-STD-129.

## 6. NOTES

**6.1 Intended use.** The impregnated cloth is

intended to be used for camouflage-net garnishing and cover.

**6.2 Ordering data.** Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type and color number required (see 1.2).
- (c) Width required (see 3.18).
- (d) Administrative provisions for inspection records (see 4.1).
- (e) Lot size for production intervals required (see 4.4.1.2.4).
- (f) Level of packing and level of packing required (see 5.1 and 5.2).
- (g) When alternate packing is required (see 5.2.1.1.1, 5.2.1.1.2, and 5.2.2).

**6.3 Formulation of vehicle.** The vehicle formulation in table VII was found to meet the performance requirements and is suggested for use as a guide only. The Government assumes no responsibility for this formulation.

TABLE VII. Vehicle formulation.

	Percent by weight
Chlorinated paraffins (60 percent chlorine) .....	28.2
Urea formaldehyde (50 percent solids) .....	4.9
Antimony oxide .....	6.4
Zinc borate .....	4.9
Calcium carbonate .....	4.9
Aluminum stearate .....	1.5
Xylol .....	49.2

**6.4 Prime pigment formulation.** The formulations in table VIII have been found to meet the prime pigment requirements of this specification for colors 12, 9, 2, and 1.



TABLE VIII. Formulation of the pigment in percent by weight.

Color No.	Designation	TiO <sub>2</sub> Type TG	Co(OH) <sub>2</sub>	CaCO <sub>3</sub> G Grade	BaCrO <sub>4</sub>	ZnO xxx55	MnO <sub>2</sub> air floated	Fe <sub>2</sub> O <sub>3</sub>
12	39A-FG-1	66.0	15.46	10.0	1.7	3.0	0.14	3.70
9	39B-OD-I	64.0	15.32	10.0	1.7	5.0	0.23	3.75
2	39C-DG-I	71.0	15.23	10.0	0.7	1.5	0.07	1.50
1	39D-LG-I	65.0	15.98	10.0	1.7	7.0	0.32	...

**Notice.** When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation,

or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

#### Custodians:

Army—CE

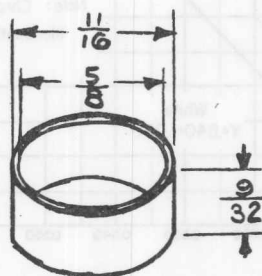
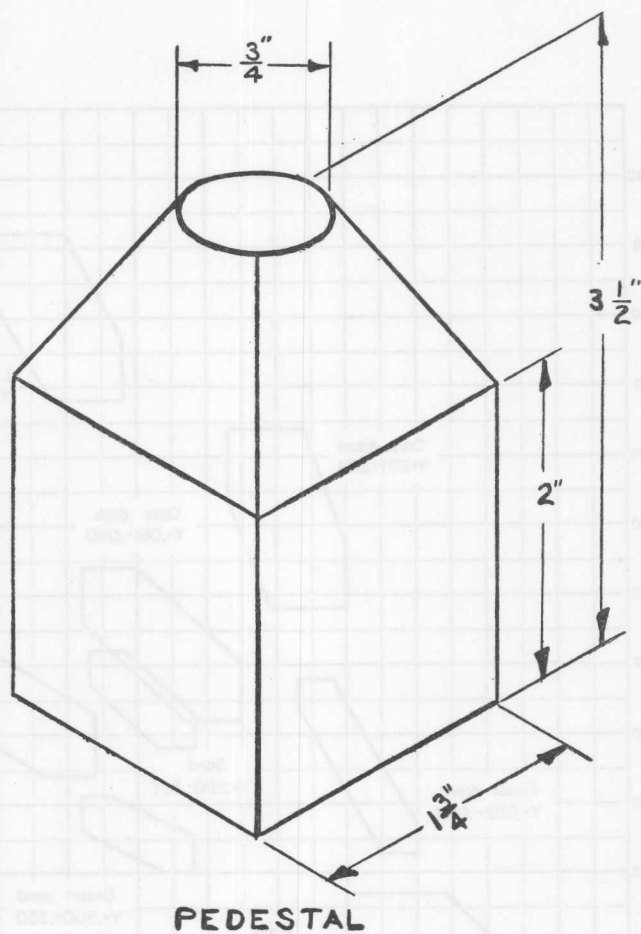
Navy—MC

Air Force—WRA

#### Preparing activity:

Army—CE

**NOTE**  
 PEDESTAL TO BE  
 MADE OF CORK OR  
 OTHER MATERIAL  
 OF LOW HEAT  
 CONDUCTIVITY



**CUP, BRASS**

**FIGURE 1. Flame resistance apparatus (vertical—method).**

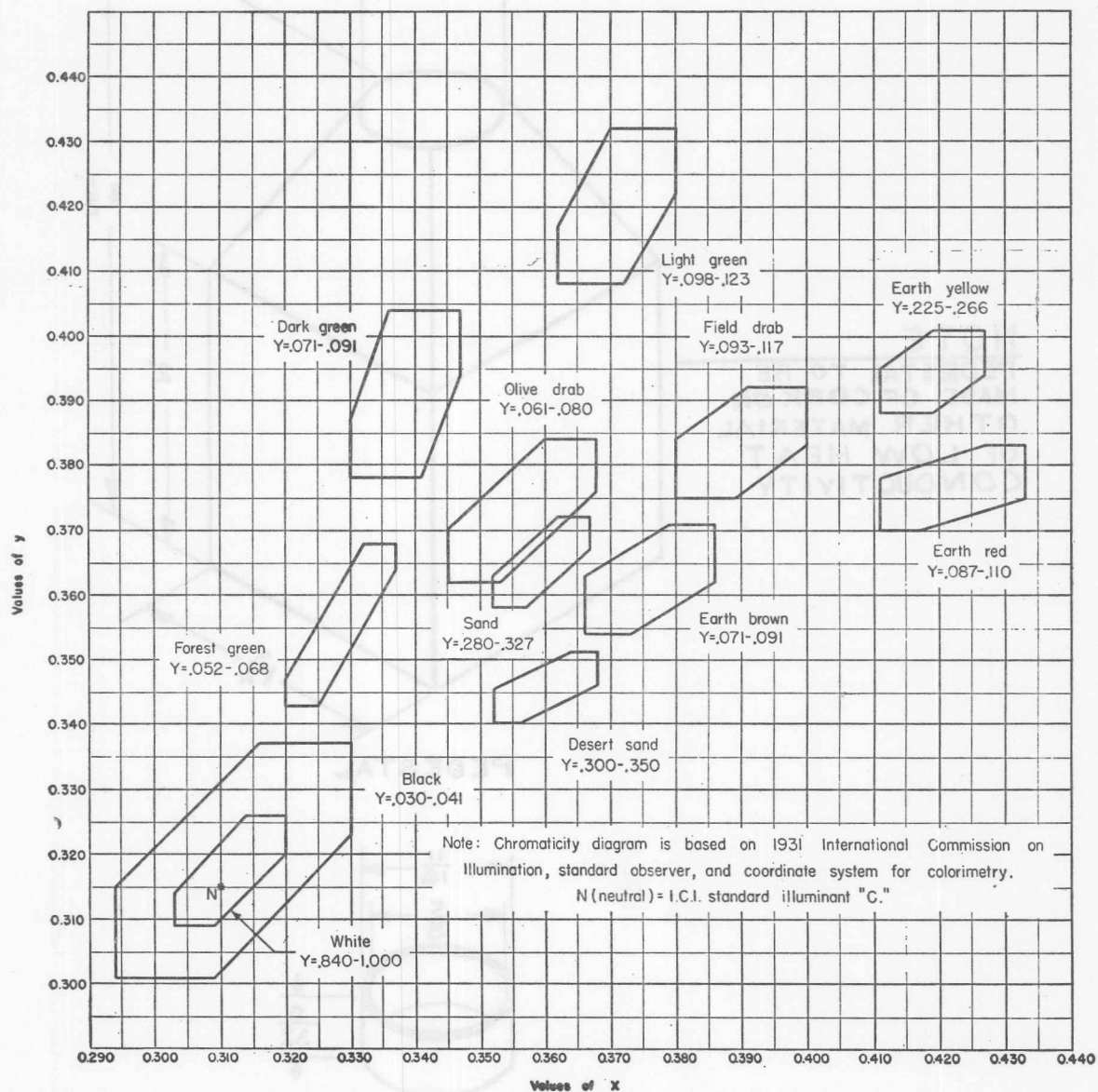


FIGURE 2. Chromaticity diagram for camouflage colors.



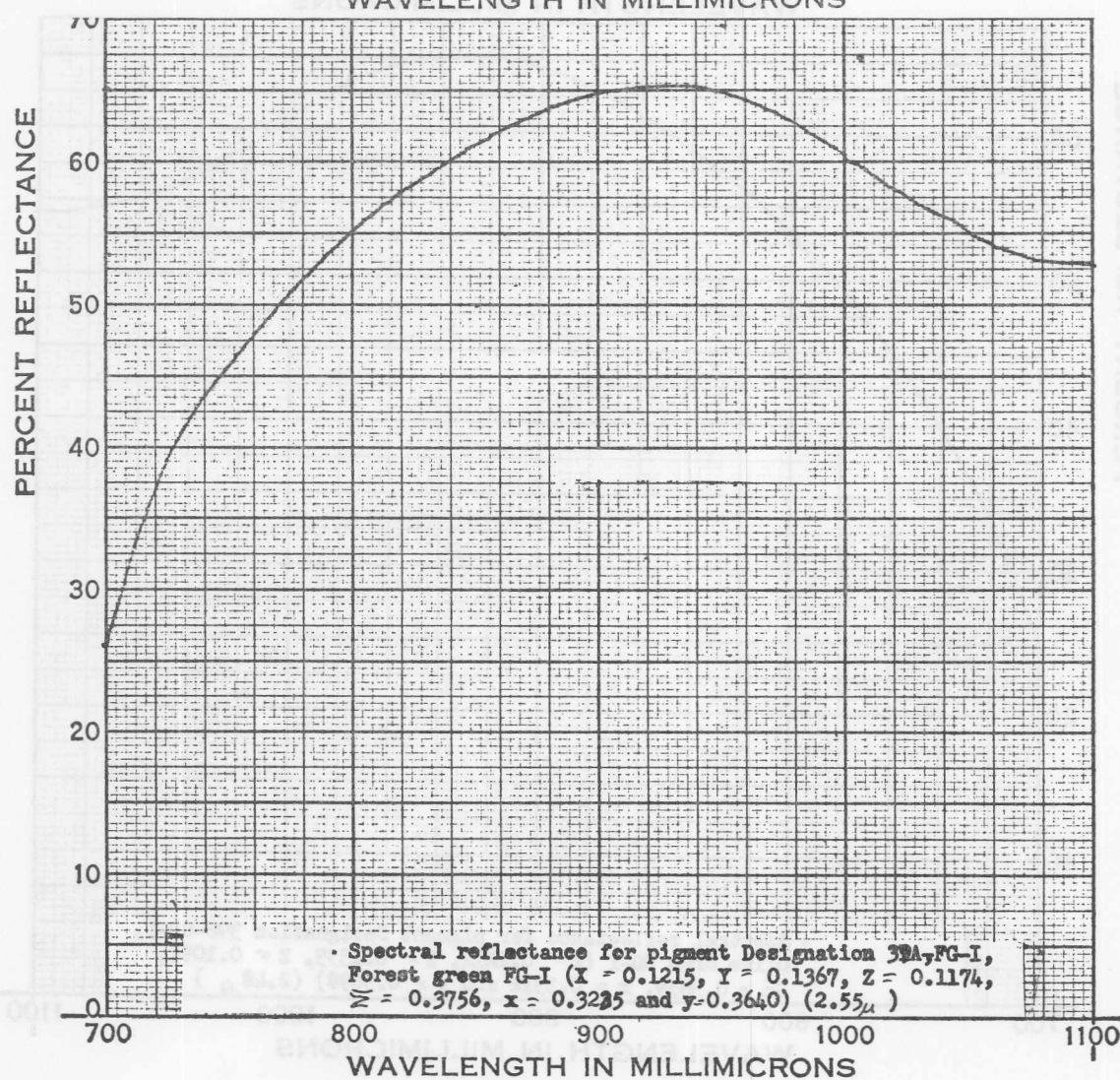
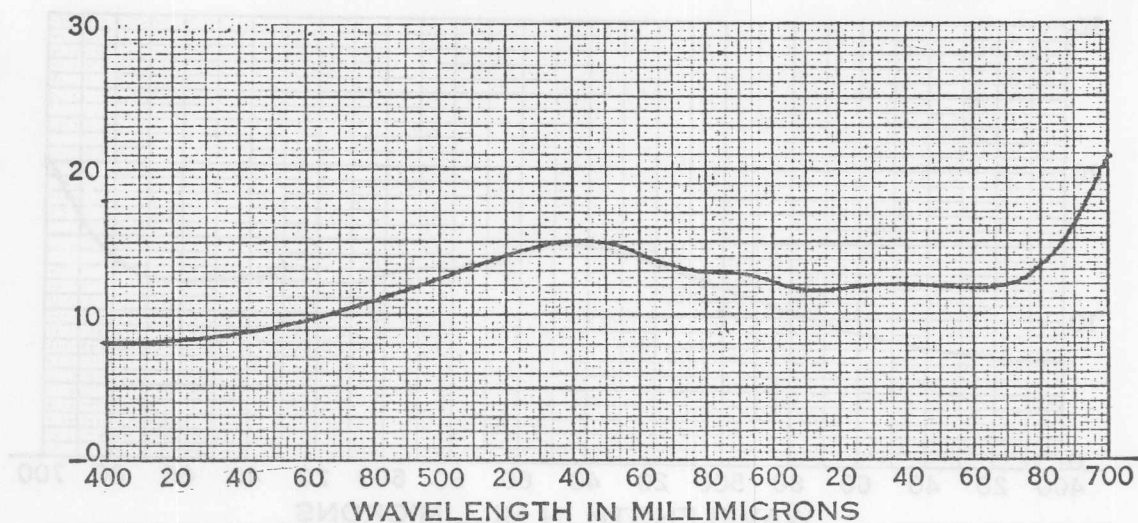
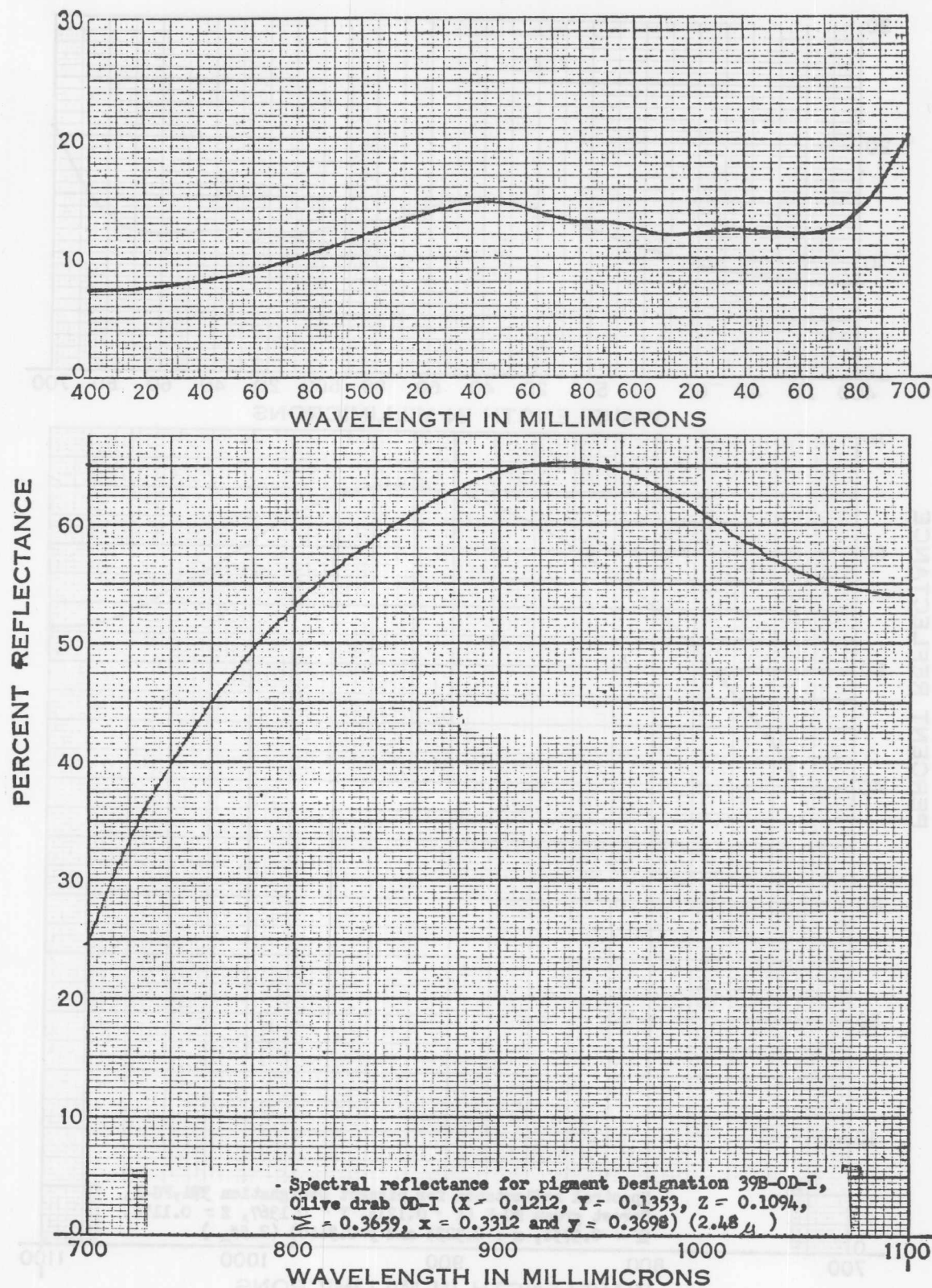


FIGURE 3. Wavelength in millimicrons.



ARMY-FORT BELVOIR, VA.

FIGURE 4. Wavelength in millimicrons.

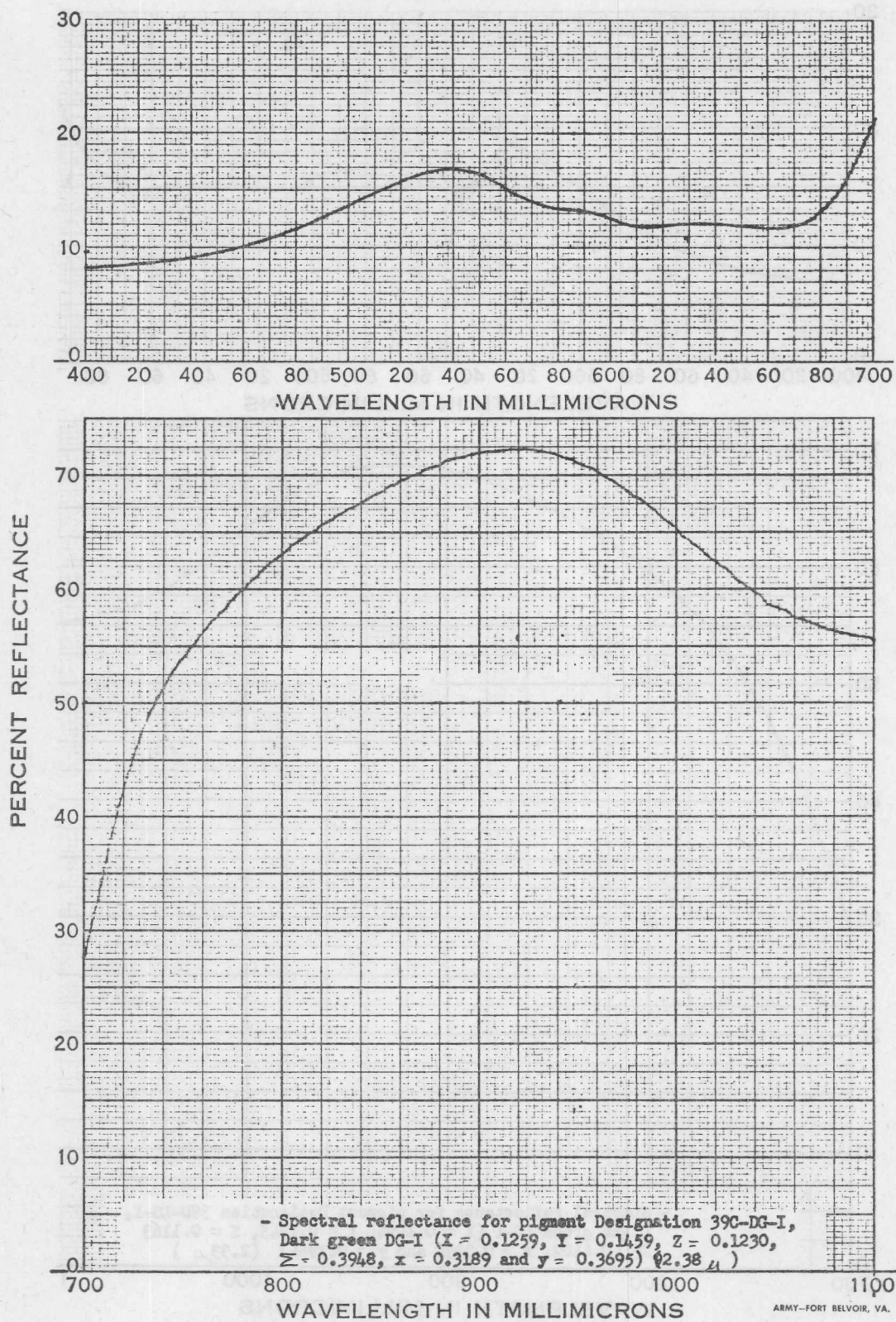


FIGURE 5. Wavelength in millimicrons.



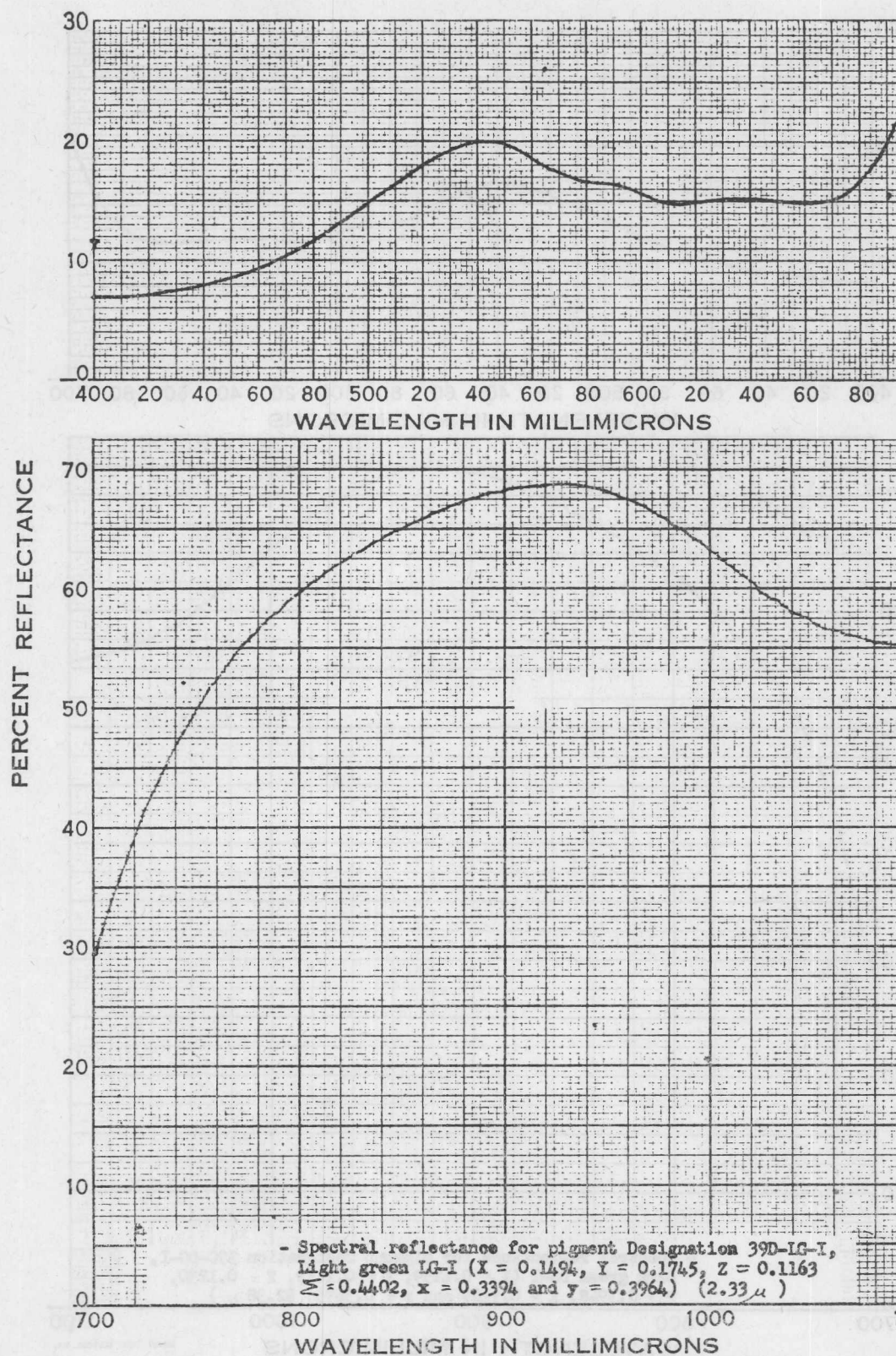


FIGURE 6. Wavelength in millimicrons.